



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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IN RE APPLN. OF: ANDRE et al.

SERIAL NO.: 09/830,380

FILED: April 25, 2001

FOR: THIN LAYER OF HAFNIUM OXIDE AND DEPOSIT PROCESS

GROUP: 1775

EXAMINER: TAMRA DICUS

DOCKET: BREV 13186

MAIL STOP APPEAL BRIEF - PATENTS

Commissioner for Patents

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APPELLANTS' REPLACEMENT BRIEF
ON APPEAL

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APPELLANTS' REPLACEMENT BRIEF ON APPEAL

This Brief is being filed in support of Appellants' Appeal from the Final Rejection by the Examiner to the Board of Appeals and Interferences, the Notice of which was timely filed under Certificate of Mailing on June 19, 2003. A Petition for a One-Month Extension of Time to File Appeal Brief was filed on August 8, 2003. Appellants' original Brief on Appeal was filed on September 2, 2003. This Replacement Brief on Appeal is being filed in response to the Notification of Non-Compliance mailed November 24, 2003.

REAL PARTY IN INTEREST

The Real Party in Interest in this Appeal is the Commissariat A L'Energie Atomique, a French National Entity having its principal place of business at 31-33 rue de la Federation, 75752 Paris 15eme, France. The Application has been assigned to Commissariat A L'Energie Atomique by the inventors Andre Bernard, Jean Dijon and Brigitte Rafin, and the Assignment

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recorded in the U.S. Patent and Trademark Office on April 25, 2001 at Reel 011832,
Frame 0050.

RELATED APPEALS AND INTERFERENCES

To the best of the knowledge of the undersigned attorney and Appellants, there are no other appeals or interferences that would directly affect, or be directly affected by, or have a bearing on, the Board's decision in the present Appeal.

STATUS OF THE CLAIMS ON APPEAL

Claims 14-23 are pending in this Application. Claims 14-23 stand finally rejected and are on Appeal. The claims on Appeal are set forth in **Appendix A** attached hereto.

STATUS OF THE AMENDMENTS

Appellants' Amendment C under Rule 116 was not entered in this case, as it was deemed not to place the Application in order for allowance.

SUMMARY OF THE INVENTION ON APPEAL

The basic idea of Appellants' invention consists of creating a thin amorphous layer of hafnium oxide using a non-energy process. By using a non-energy process, Appellants' invention avoids the prior art problems of inclusion of aggregated impurities that limit the ability of the coating to withstand laser fluxes. As used herein, the term "no energy input" means that the substrate is not heated or pre-heated and no process such as ion bombardment or ion acceleration is used. The resulting deposit is a natural deposition through the simple condensation of the hafnia on the substrate. The layer formed is amorphous, that is, non-

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crystalline, and has a density less than 8 gm/cm^3 . The main advantage of the present invention over the prior art is that it provides a layer of hafnia that is highly resistant to laser flux.

The present invention provides: "A thin layer material consisting essentially of amorphous hafnium oxide having a density less than 8 gm/cm^3 " (independent claim 14); "A stack of thin layers, comprising at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 " (independent claim 15); and "An optical component having on at least one surface at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 " (independent claim 20). (See **Appendix A**).

ISSUE PRESENTED ON APPEAL

The sole issue is whether claims 14-23 are unpatentable under 35 USC § 103(a) over Ando et al. (US Patent No. 5,399,435) in view of Lazarov et al. (US Patent No. 5,670,248) and further in view of Floch et al. (US Patent No. 5,623,375).

THE FINAL ACTION

More particularly, in finally rejecting the claims on Appeal, the Examiner states the following:

Claims 14-23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over USPN 5,399,435 to Ando et al. in view of USPN 5,670,248 to Lazarov et al. and further in view of USPN 5,623,375 to Floch et al.

Ando teaches an amorphous hafnium oxide thin film (layer) on a glass, or plastic substrate at col. 1, lines 10-15, col. 2, lines 29-40, and col. 3, lines 12-53. Such a thin film may be included in a stack of thin layers, where a metal oxide, such as silicon oxide may be above or below an amorphous hafnium oxide layer (see col. 9, lines 25-65), which may be any optical component such as a mirror, glass, or camera lens at col. 1,

lines 10-16.

Ando does not explicitly state the density of an amorphous hafnium oxide layer. Nevertheless, Lazarov teaches material in amorphous form of a metal such as hafnium oxide that may have a density between 3.7 and 4.5 g/cm³, meeting the Applicant's [sic] limitation of a density less than 8 g/cm³. See col. 3, lines 22-25, 30-39, 62-63 and col. 5, line 12. Hence, it would have been obvious to one of ordinary skill in the art to modify the thin layer or stack of layers of Ando to produce a film that may be employed as an antireflective filter, optimizing adsorption of wavelengths for use in various industries as taught by Lazarov at col. 5, lines 10-47.

While Ando does not specifically state amorphous hafnium oxide being in alternate layers, he does state since the substrate may be of any metal oxide, such as silica at col. 9, line 30-31, a stack of layers comprising amorphous hafnium oxide may be on each side of the substrate. In addition, Floch teaches it is well known to produce layers of metal oxides, such as hafnium and silicon in alternating fashion in order to produce optical articles such as mirrors that have a desired wavelength at col. 3, lines 4-25. Therefore it would have been obvious to one of ordinary skill in the art to modify the stack of films of Ando to include alternative layers of amorphous hafnium oxide as taught by Ando to produce a different arrangement and also by Floch to prevent cracks and vary the refractive indices depending upon the desired wavelength or thickness of a stack of thin films or optical component.

All references are analogous art as both references are in the same field of endeavor, such as optical film technology.

Detailed Action, cipher 2, pages 2-3.

GROUPING OF CLAIMS

Claims 14, 15-19 and 20-23, respectively, while containing a common patentable feature, are also independently patentable.

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THE REFERENCES

Ando et al., U.S. Patent No. 5,399,435 ("Ando et al.")

Ando et al. has as their object to provide a durable, scratch resistant coating for a mirror or lens. Ando et al. teaches using an amorphous oxide film composed essentially of an oxide that contains at least one member selected from the group consisting of Zr, Ti, Hf, Sn, Ta and In and at least one member selected from the consisting of B and Si. That is, Ando et al. teaches a mixture of a selected metal oxide combined with boron or silicon. Some examples of types of compounds taught include (using zirconium as the metal): $Zr-ZrB_2$, ZrB_2 , ZrB_2-B , $ZrSi_2$, ZrB_2-Zr_2 , ZrB_2-ZrSi_2-Si , ZrB_2-ZrSi_2-Si , TiS_2 , ZrB_2-ZrO_2 (wherein the symbol "—" means a mixture of). See Ando et al., Table 1.

According to Ando et al., the inclusion of boron or silicon in the layer is considered essential. This reference teaches that "[B] and Si contribute to the realization of a film having excellent durability satisfying both the abrasion resistance and the chemical stability... Further, B and Si contribute also to the control of the refractive index of the film, [which allows for control of the transmittance, the reflectance and color tone of the film]." (Column 12, lines 47-56).

Lazarov et al., U.S. Patent No. 5,670,248 ("Lazarov et al.")

Lazarov et al. teaches a material used to convert radiation energy to heat energy, or to serve as an anti-reflective layer, or a radiation emitter, or an anti-microbial agent. The material is composed of a metal from Group IV of the Periodic Chart, nitrogen and oxygen, and has a formula MN_xO_y , where "M" indicates the metal of Group IV A of the Periodic Chart and x and y

have the values 0.1 to 1.7. Fifty-five to ninety-eight percent of the volume of the material is filled by the metal-nitrogen-oxygen material with voids or empty spaces filling the remaining two to forty-five percent of the volume. Lazarov et al. adds voluntarily some impurities to make the coating absorbing contrary to the instant claimed invention, which, by virtue of the closed claim language, excludes added materials.

Lazarov et al. also teaches that other compounds can be added to the MN_xO_y to increase the range of possible applications of their invention. Specifically, the supplemental compounds comprise preferably one or more of the chemical compounds selected from MN_x ($x = 0.7$ to 1.2), M_nO_{2n-1} , MO_2 , M_2N as well as approximately 0-30%, preferably 0.5-5%, of carbon compounds of a metal of Group IV A of the Periodic Chart.

According to Lazarov et al., the mass densities of their materials preferably lie in the range from 3.7 to 4.5 gm/cm³.

Floch et al., U.S. Patent No. 5,623,375 ("Floch et al.")

Floch et al. teaches an interferential or interference dielectric mirror. The mirror includes a ground and planar substrate, whose surface has been replicated with a thermal plastic resin. The ground substrate in the dielectric mirror is covered with at least one layer of colloids and at least a second layer of colloids having a refractive index higher than that of the first layer.

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ARGUMENT ON APPEAL

**THE REJECTION OF CLAIMS 14-23 UNDER
35 USC § 103(A) AS UNPATENTABLE OVER
ANDO ET AL. IN VIEW OF LAZAROV ET AL.
AND FURTHER IN VIEW OF FLOCH ET AL. IS
IMPROPER BECAUSE THE COMBINATION OF
THESE REFERENCES DOES NOT TEACH OR
RENDER OBVIOUS APPELLANTS' INVENTION.**

A. Background Of The Invention On Appeal

Hafnium oxide or hafnia, HfO_2 , is used in multi-layer coating of optical components. The multi-layer coating has to withstand the laser flux felt by these components. The damage caused to the optical components by the laser flux is a limiting factor in the maximum working laser fluences. The multi-layer compounds aim at guiding the laser flux by alternatively depositing material with high and low indices of reflection. This causes most of the energy of the beam that hits the surface of the coating to be reflected and not absorbed. The hafnia layer withstands a high laser energy from laser light with wavelengths from ultraviolet to infrared.

Traditionally, hafnium oxide is deposited by vacuum evaporation. One method involves using an electron gun to heat a target of hafnia in a vacuum chamber, which causes a deposition of a substrate of hafnium oxide on the component. Another method involves introducing hafnium into a vacuum chamber containing oxygen under a very lower pressure and then depositing the product of the oxidation on the component.

One characteristic of these evaporation deposition methods is that porous layers are produced. This is because the time interval between the deposition of two successive atom mono-layers and the energy brought to the sample are not sufficient for inducing the compaction of layers, and therefore the deposited material is porous. Production of layers becomes more

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difficult because of the introduction of mechanical tension stress into the layers, time evolution of the optical response of the component and process drift.

To minimize these phenomena, the prior art has proposed processes to increase the density of the coating. To densify the layers, energy is inputted during the growth process by heating the substrates or by using ion bombardment. The added energy encourages crystalline growth in the coating. However, the crystalline growth allows the diffusion of impurities throughout the layer.

B. The Primary Reference Ando et al. Fails to Teach the Claimed Invention, and in Fact, Teaches away from the Claimed Invention.

Independent claim 14 requires "A thin layer material consisting essentially of amorphous hafnium oxide having a density less than 8 gm/cm³."

Independent claim 15 requires "A stack of thin layers, comprising at least one layer amorphous hafnium oxide having a density less than 8 gm/cm³."

Independent claim 20 requires "An optical component having on at least one surface at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm³." In the Advisory Action, the Examiner, while refusing to enter Applicants' after final amendment characterized the claims as being one in the same as "an amorphous oxide ... consisting of ... Hf." In other words, the Examiner read all of the independent claims as having the closed "consisting essentially of" language.

In finally rejecting the claims, the Examiner took the position: "Ando describes the very oxide Applicant claims, HfO₂," and he stated: "an amorphous oxide ... consisting of ... Hf [...], is one in the same." (Advisory Action, continuation sheet). While Ando et al. might teach an

amorphous oxide containing Hf as part of a mixture, the Examiner's selective quoting distorts and misrepresents the teaching of Ando et al. What Ando et al. actually teaches is:

. . . an amorphous oxide film composed essentially of an oxide containing at least one member selected from the group consisting of Zr, Ti, Hf, Sn, Ta and In and at least one member selected from the group consisting of B and Si. (emphasis added)

(Col. 9, lines 21-25 and 35-38; Abstract). That is, Ando et al. teaches a mixture containing an oxide of various metals which may include hafnium, and further containing either or both boron and silicon. Therefore, at best, Ando et al. teaches a mixture in which HfO₂ may be a member, along with either or both boron and silicon.

Moreover, all of the working examples in Ando et al. describe the inclusion of boron or silicon. (See Table 1; col. 3, lines 54-55). These examples contain zirconium instead, not hafnium, and clearly demonstrate that Ando et al. does not teach or suggest a layer consisting only of an amorphous oxide of Hf. Table 1 teaches using a layer of: Zr—ZrB₂, ZrB₂, ZrB₂—B, ZrSi₂, ZrB₂—Zr₂, ZrB₂—ZrSi₂—Si, ZrB₂—ZrSi₂—Si, TiS₂, ZrB₂—ZrO₂ (wherein the symbol “—” means a mixture of). All the possible exemplary substances in Table 1 contain either Si or B, not just an oxide film. Therefore, Ando et al. does not teach a thin layer material consisting essentially of amorphous hafnium oxide, or a stack of thin layers including at least one layer of amorphous hafnium oxide, or an optical component having on at least one surface at least one layer of amorphous hafnium oxide, having a density less than 8 gm/cm³ as required by independent claims 14, 15 and 20.

In the Final Rejection and also in the Advisory Action, the Examiner insists that Ando et al. teaches a layer of amorphous hafnium oxide, with declarative statements about the

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“unassailability” of the evidence, but does not explain her conjecture that Ando et al. teaches “the very oxide Applicant claims” other than to erroneously state “ ‘an amorphous oxide ... consisting of ... Hf’ is one in the same” [as an oxide film containing hafnium oxide and boron or silicon as taught by Ando et al.]. (Advisory Action pg. 2).

Moreover, Ando et al. actually teaches away from a layer consisting only of an oxide of Zr, Ti, Hf, Sn, Ta and In. In Ando et al., crystalline ZrO₂ film is used as a “comparative example” in Table 1, not as an example of Ando et al.’s invention. Ando et al.’s motivation of their invention is to find “a thin film, which is excellent [in] scratch resistance, [and] abrasion resistance.” According to Ando et al., a crystalline ZrO₂ film fails both of Ando et al.’s scratch and abrasion resistance tests. Ando et al. states:

[I]t is believed that by the addition of B to a ZrO₂ film ... the surface becomes smooth, whereby the abrasion resistance and the scratching resistance are improved. Further, it is possible to control the refractive index by adjusting the amount of B. Furthermore, as compared with the ZrO₂ film, the internal stress is small, which is advantageous for the adhesion to the substrate (glass, plastics, etc.) or to a primer coating layer on the substrate.

(Col. 5, lines 34-44). Thus, Ando et al. teaches away from a thin layer consisting only of a hafnium oxide layer.

Furthermore, independent claim 14 specifies a thin layer “consisting essentially of amorphous hafnium oxide.” The transition phrase “consisting essentially of” limits the scope of a claim to the specified materials or steps “and those that do not materially affect the basic and novel characteristic(s)” of the claimed invention. *In re Herz*, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976) (emphasis removed); MPEP 2111.03. The films taught in Ando et al. are

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materially different than a thin layer material consisting essentially of amorphous hafnium oxide and therefore cannot be said to teach or suggest claim 14 of Appellants' invention.

Similarly, independent claim 15 calls for "a stack of thin layers, comprising at least one layer of amorphous hafnium oxide" While claim 15 may employ the open-ended term "comprising," the term "comprising" is used in connection with the number of layers, rather than the makeup of the layers. Since claim 15 is specifically limited to "at least one layer of amorphous hafnium oxide ...", as noted *supra*, and Ando et al. teaches a mixture of a selected metal oxide combined with boron or silicon, the primary reference Ando et al. cannot be said to teach "a stack of thin layers comprising at least one layer of amorphous hafnium oxide ..." as required by independent claim 15. Nor can Ando et al. be said to teach "an optical component having on at least one surface at least one layer of amorphous hafnium oxide ..." as required by independent claim 20. Thus, none of the independent claims 14, 15 and 20, or claims 16-19 and 21-23, which depend directly or indirectly on claims 15 and 20, as the case may be, can be said to be anticipated by Ando et al.

C. None of the Secondary References Lazarov et al. and Floch et al. Alone or in Combination Provides the Missing Teachings to Ando et al. to Achieve or Render Obvious the Claimed Invention.

Independent claims 14, 15 and 20 all require "a ... layer ... of amorphous hafnium oxide ... having a density less than 8 gm/cm³." The Examiner acknowledges that the primary reference Ando et al. does not teach the density as claimed, but looks to Lazarov et al. for this missing teaching: "[L]azarov teaches the density of hafnium oxide is between 3.7 and 4.5 gm/cm³." (Advisory Action pg. 2). The Examiner's reliance on Lazarov et al. is misplaced. Lazarov et al. does not teach a layer of hafnium oxide having a density between 3.7 and 4.5

gm/cm³. Lazarov et al. teaches a complex substrate consisting of multiple compounds of predominately nitrogen and oxygen along with large empty spaces which collectively may have a mass density between 3.7 and 4.5 gm/cm³. (Col. 3, lines 61-63). Specifically, Lazarov et al. states

[2] to 45%, preferably from 5 to 40%, very preferably from 10 to 28% of the volume are formed by voids (empty spaces) ... The remaining volume of the material (98-55%, preferably 95- 60%) exhibits a composition of the group IV metal of the periodic system to nitrogen to oxygen of 1:(0.1 to 1.7):(0.1 to 1.7), preferably 1:(0.25 to 1.5):(0.25 to 1.5). The material has the formula MN_xO_y, where "M" indicates the metal of group IV A of the periodic system and _x or _y the values 0.1 to 1.7.

(Col. 3, lines 6-17). Along with the MN_xO_y, Lazarov et al. teaches including "supplementary contained compounds" to increase the range of application for the invention. (Col. 3, lines 26-28). Lazarov et al. asserts

[t]he 'remaining volume' of the material comprises preferably one or more of the chemical compounds selected from MN_x (x=0.7 to 1.2), Magnelli phases of the M-O system (M_nO_{2n-1}), MO₂, M₂N (with M=metal from group IV A of the periodic system) as well as approximately 0-30%, preferably 0.5-5%, of carbon compounds of a metal of group IV A of the periodic system.

(Col. 3, lines 20-25). Thus, Lazarov et al. does not teach a layer of hafnium oxide having a density between 3.7 and 4.5 gm/cm³. Rather, Lazarov et al. teaches a complex substrate consisting of MN_xO_y, and preferably one or more of MN_x, M_nO_{2n-1}, MO₂, M₂N and carbon compounds of a metal of Group IV A, which collectively has a density between 3.7 and 4.5 gm/cm³. The language of independent claims 14, 15 and 20 requires a layer of amorphous hafnium oxide.

At page 4 of the Final Action, the Examiner argues:

Lazarov makes reference to a thin layer HfO_2 as an additional single layer at col. 5, line 12. Further referencing the total mass density [of the compound mentioned above], it would have been obvious to one of ordinary skill in the art to modify only follow [sic] that the density for HfO_2 would be less than 8 g/cm^3 .

It is submitted that it would not be obvious or even logical to assume that just because one substrate has a certain density that all of the layers would have the same density. Therefore, Lazarov et al. cannot be said to teach a layer of hafnia with a density less than 8 gm/cm^3 , as required by Appellants' claims. Thus, Lazarov et al. does not supply this missing teaching to Ando et al.

Floch et al. also fails to supply the missing teachings to Ando et al. or the combination of Ando et al. and Lazarov et al. to achieve or render obvious the claimed invention. Floch et al. is concerned with a dielectric mirror, but does not teach anything about mass densities. Thus, no combination of Ando et al., Lazarov et al. or Floch et al. could achieve or render obvious Appellants' independent claims 14, 15 and 20.

Claims 16-18 depend directly or indirectly on claim 15 and are allowable over the art for the same reasons above adduced relative to claim 15, as well as for their own additional limitations.

Claims 21-23 are directly or indirectly dependent on claim 20 and are also allowable over the art for the same reasons above adduced relative to claim 20.

In summary, independent claim 14 is directed to a thin layer material defined by closed language "consisting essentially of" amorphous hafnium oxide having a density less than 8 gm/cm^3 . This is neither taught nor suggested by any of the art alone or in combination, since

none of the art teaches or suggests a thin layer material consisting essentially of amorphous hafnium oxide having a density less than 8 gm/cm^3 .

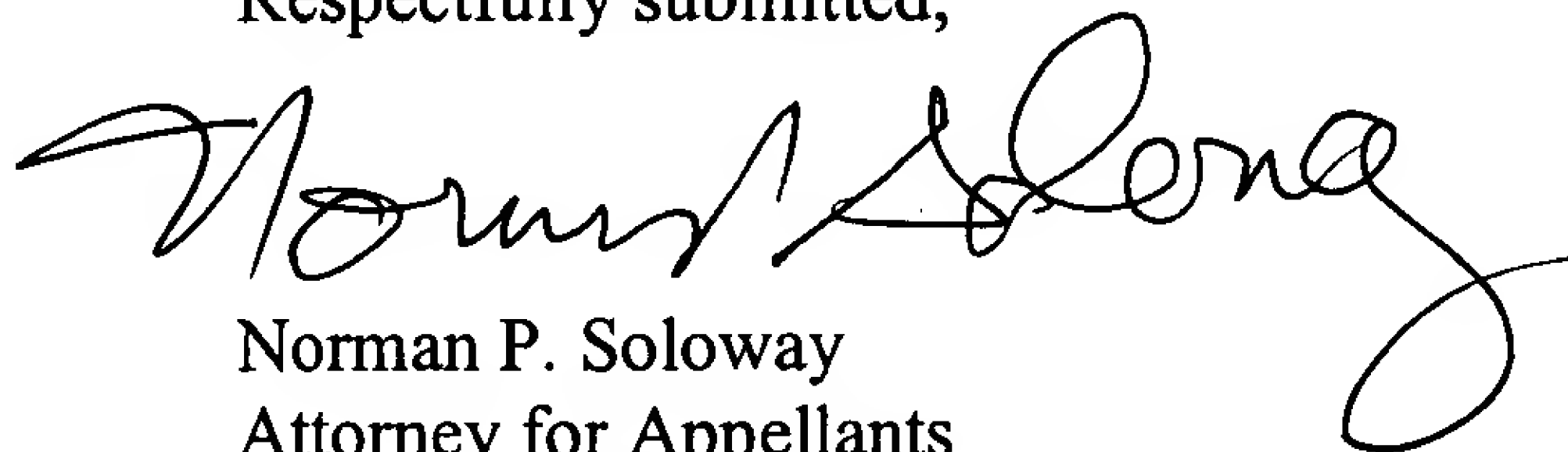
Nor does the art, alone or in combination, teach a stack of thin layers comprising at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 , as required by claim 15, and the several claims 16-19 which depend directly or indirectly thereon.

Finally, independent claim 20, which is directed to an optical component having on at least one surface at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 , cannot be said to be anticipated by or obvious from the art alone or in combination, since none of the art teaches or suggests a layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 . Thus, claim 20, and claims 21-23, which depend directly or indirectly thereon, also cannot be said to be anticipated by or obvious from the art.

CONCLUSION

In view of the foregoing, it is respectfully requested that the Examiner's Rejection of the subject Application be reversed in all respects.

Respectfully submitted,




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**APPELLANTS' REPLACEMENT BRIEF ON
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APPENDIX A

(Claims on Appeal)

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APPENDIX A

CLAIMS ON APPEAL

14. A thin layer material consisting essentially of amorphous hafnium oxide having a density less than 8 gm/cm^3 .
15. A stack of thin layers, comprising at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 .
16. The stack of thin layers as claimed in Claim 15, wherein the stack comprises at least one layer of another material formed on a surface of the amorphous hafnium oxide layer.
17. The stack of thin layers as claimed in Claim 16, wherein said another material comprises silicon oxide.
18. The stack of thin layers as claimed in Claim 15, wherein the stack comprises alternate layers of amorphous hafnium oxide having a density less than 8 gm/cm^3 and another material.
19. The stack of thin layers as claimed in Claim 18, wherein said another material comprises silicon oxide.
20. An optical component having on at least one surface at least one layer of amorphous hafnium oxide having a density less than 8 gm/cm^3 .
21. The optical component as claimed in Claim 20, and comprising a stack of thin layers of amorphous hafnium oxide.

APPENDIX A - APPELLANTS' BRIEF ON APPEAL

22. The optical component as claimed in Claim 21, wherein the stack comprises alternate layers of amorphous hafnium oxide having a density less than 8 gm/cm³ and another material.

23. The optical component as claimed in Claim 22, where said another material comprises silicon oxide.

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